Science Mission Directorate

NASA Headquarters Update

Ramesh Kakar
Aqua Program Scientist
March 17, 2014

Aqua Instrument Status

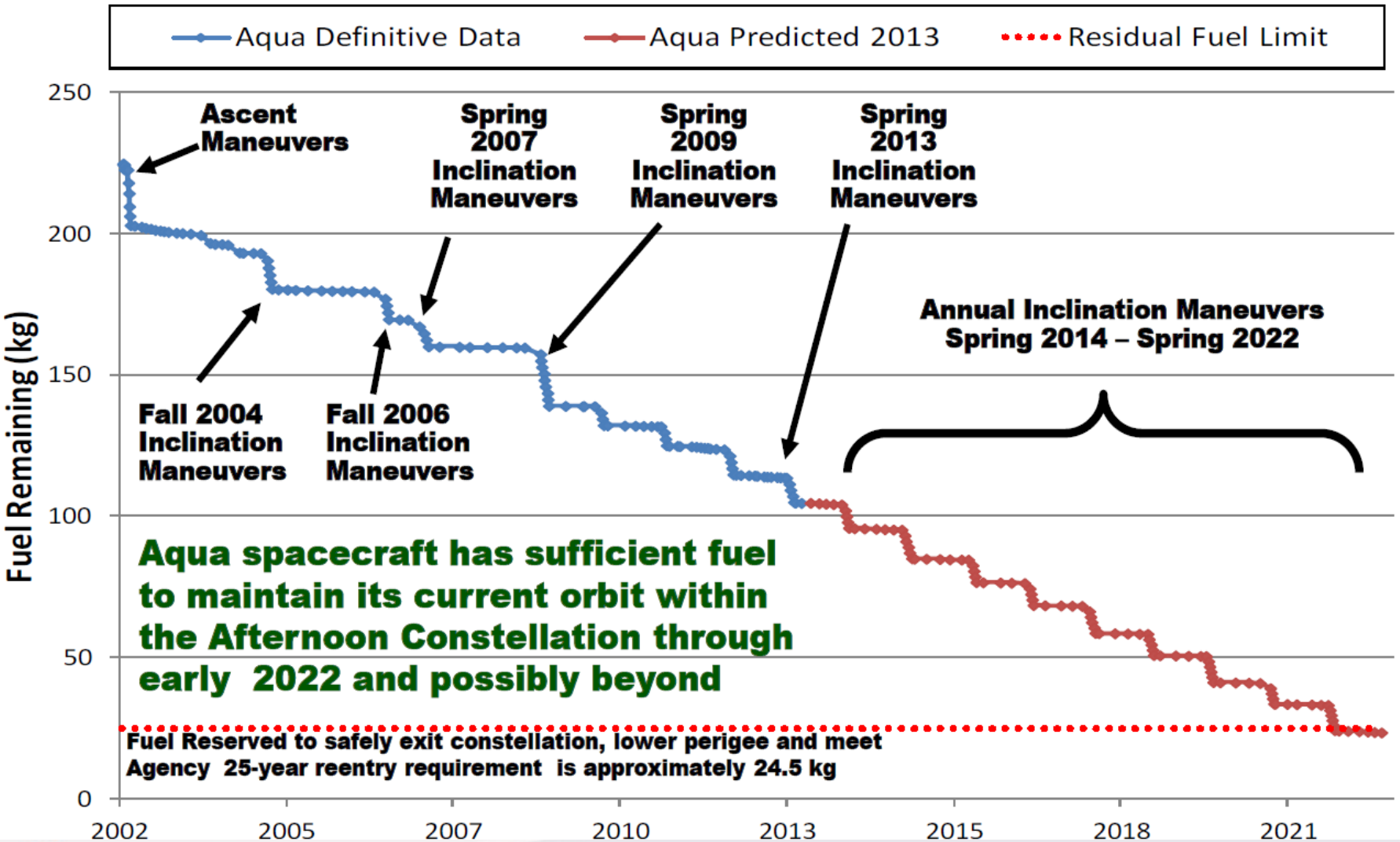
Instrument Status

- AIRS – Nominal Operations
  - 02/08/2013: Scanner Shut Down Anomaly – Recovered 02/09
  - 04/05/2013: Science Data Anomaly – Recovered 04/06
  - All voltages, currents, and temperatures as expected
- AMSU-A – Nominal Operations except for Channels 4 & 5
  - All voltages, currents, and temperatures as expected
  - 03/05/2008: GES DISC removed Channel 4 data from level 2 processing
  - 04/13/2012: GES DISC removed Channel 5 data from level 2 processing
- AMSR-E - ADE Motor Current & Commanded Torque Increasing (April 2007)
  - 10/04/2011: Antenna anomaly and spin down to 0 RPM
  - 02/06/2012: Turned instrument on – no antenna rotation
  - 09/19/2012: Spin-up/Spin-down Tests – total of 6 over 2-days
  - 12/04/2012: Spin-Up to ~2.0767 RPM
  - 03/11/2013: Meeting with JAXA/MELCO Team in Tokyo
  - 12/18/2013: 12-Month Status Briefing – No performance or data processing issues
- CERES-FM4 instrument shortwave anomaly (CERES-Fore) – no impact to science
  - CERES-Aft is prime CERES instrument on Aqua
  - 10/20/2011: CERES-Fore Temperature Anomaly – Recovered on 12/15/2011
- MODIS – Nominal Operations – 02/09/2014 LCM #112 – next 03/11/2014 (#113)
- HSB – OFF (Survival Mode)

No Changes

Fuel Usage: Actual & Predicted

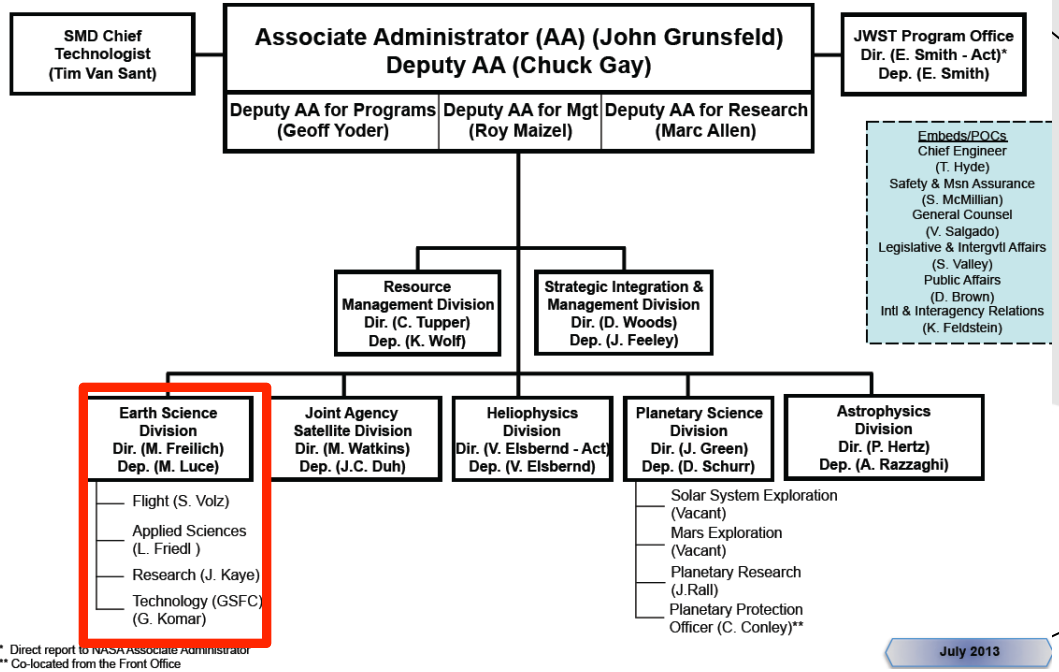
(August 2013)

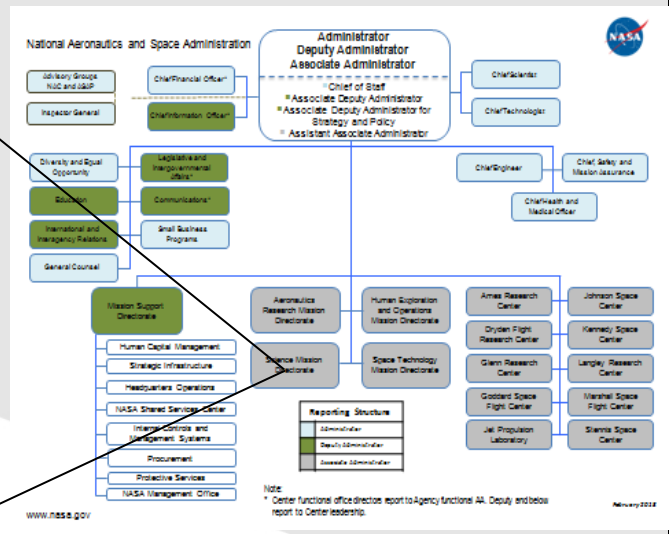


NASA Earth Science – Organizational Context

NASA's Science Mission Directorate (SMD) conducts scientific exploration enabled by the use of space observatories and space probes that view the Earth, observe and visit other bodies in the solar system, and gaze out into the galaxy and beyond. NASA's science program seeks answers to profound questions that touch us all. This combined organization is able to establish an understanding of the Earth, other planets, and their evolution; bring the lessons of our study of Earth to the exploration of the Solar System; and assure the discoveries made here will enhance our work there.

SMD Organization





Earth Science – NASA's Strategic Goal

Understanding the complex, changing planet on which we live, how it supports life and how human activities affect its ability to do so in the future is one of the greatest intellectual challenges facing humanity. It is also one of the most important challenges for society as it seeks to achieve prosperity, health, and sustainability. - NRC, 2007

NASA's Strategic Goal:

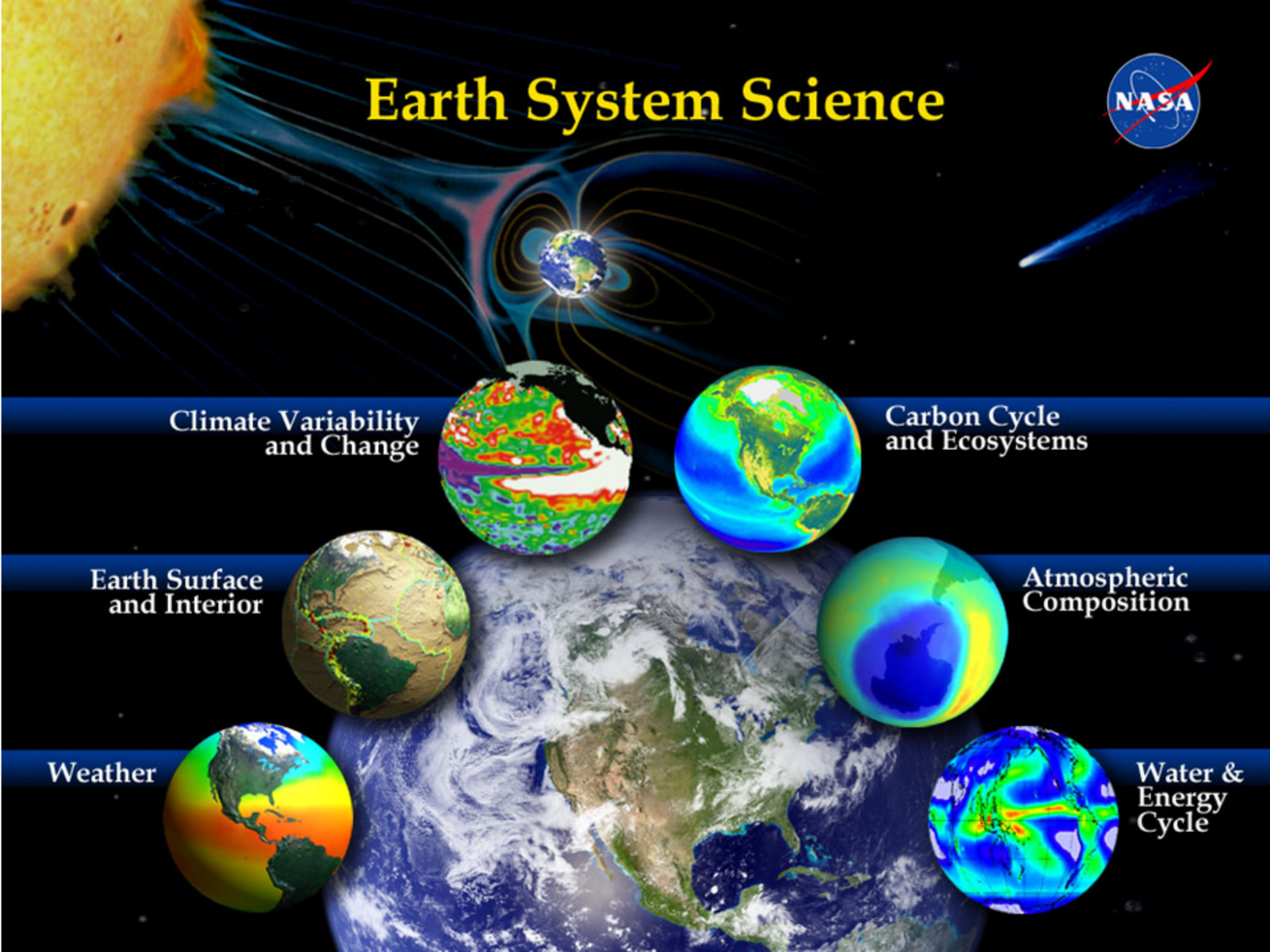
"Advance Earth System Science to meet the challenges of climate and environmental change."

Earth Science Division Overview

- Overarching goal: to **advance Earth System science**, including climate studies, through spaceborne data acquisition, research and analysis, and predictive modeling

- Major activities:
  - **Building and operating Earth observing satellite missions**, many with international and interagency partners
  - **Making high-quality data products** available to the broad science community
  - **Conducting and sponsoring cutting-edge research**
    - Field campaigns to complement satellite measurements
    - Analyses of data from NASA and non-NASA missions
    - Modeling
  - **Demonstrating applications** that deliver societal benefit
  - **Developing technologies** to improve Earth observation capabilities

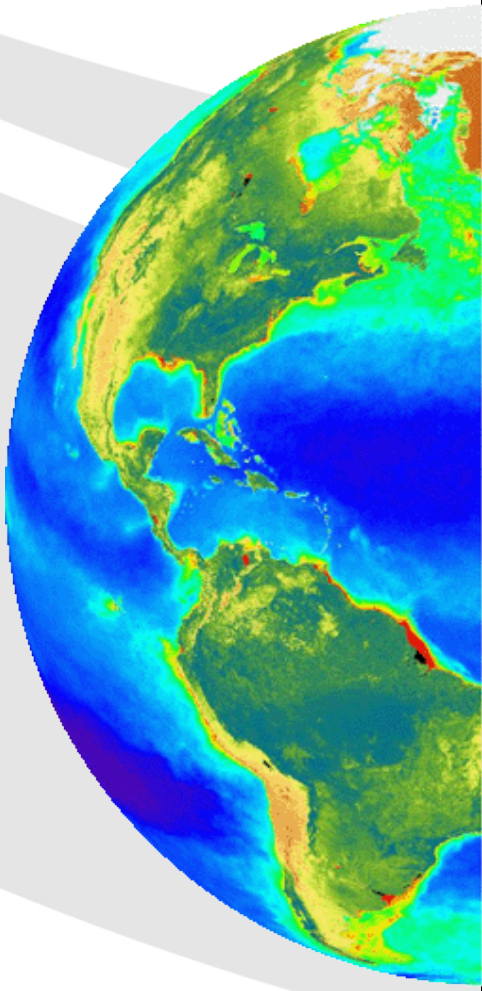
Earth System Science



Earth Science Questions*

How is the Earth changing and what are the consequences for life on Earth?

- How is the global Earth system changing? (***Characterize***)
- What are the sources of change in the Earth system and their magnitudes and trends? (***Understand***)
- How will the Earth system change in the future? (***Predict***)
- How can Earth system science improve mitigation of and adaptation to global change? (***Apply***)



*NASA 2010 Science Plan

Guiding Documents

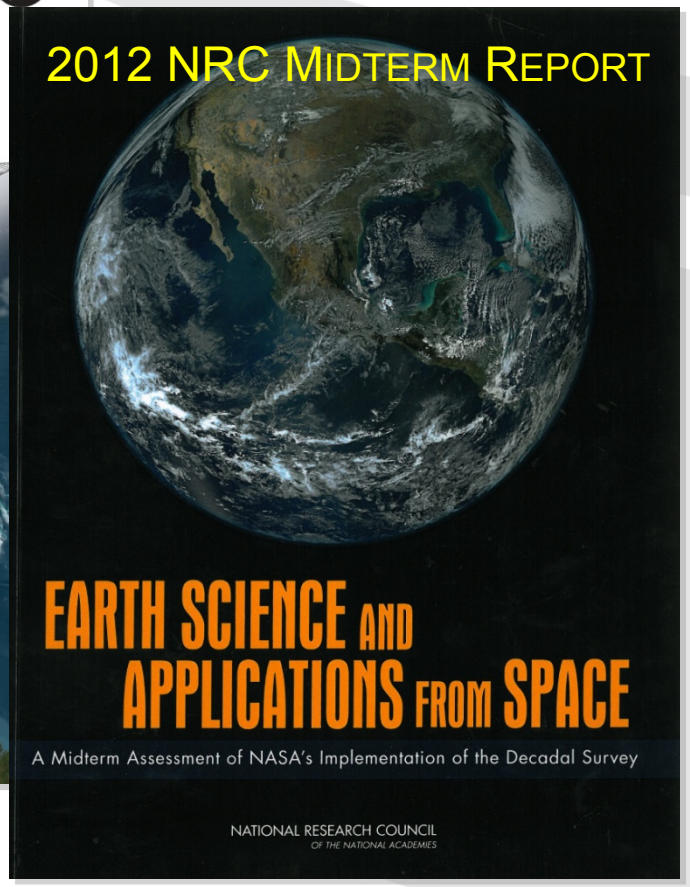
2007 Decadal Survey

- Recommended priorities for future missions and research
- 15 missions in small, medium and large categories
- Earth Venture class of competed, innovative small missions

2010 NASA Response to Climate Plan

- Identified new Climate Measurements and replacement for OCO
- SAGE III ISS, PACE, OCO-2, OCO-3 MOO, GRACE FO
- Evaluated and endorsed by 13-agency USGCRP

2012 NRC Midterm Report



- Endorsed NASA's implementation
- Recommended adding more Earth Venture small satellite missions
- Encouraged rigorous cost control

Mission Classes

Systematic Observation Missions (Directed)

- Produce long-term data sets
- Earth Observing System (EOS), Foundational, Decadal Survey Tier 1-2-3, Climate Continuity

Exploratory Missions (PI-lead)

- Make new or one time measurements
- Earth System Science Pathfinder (ESSP)

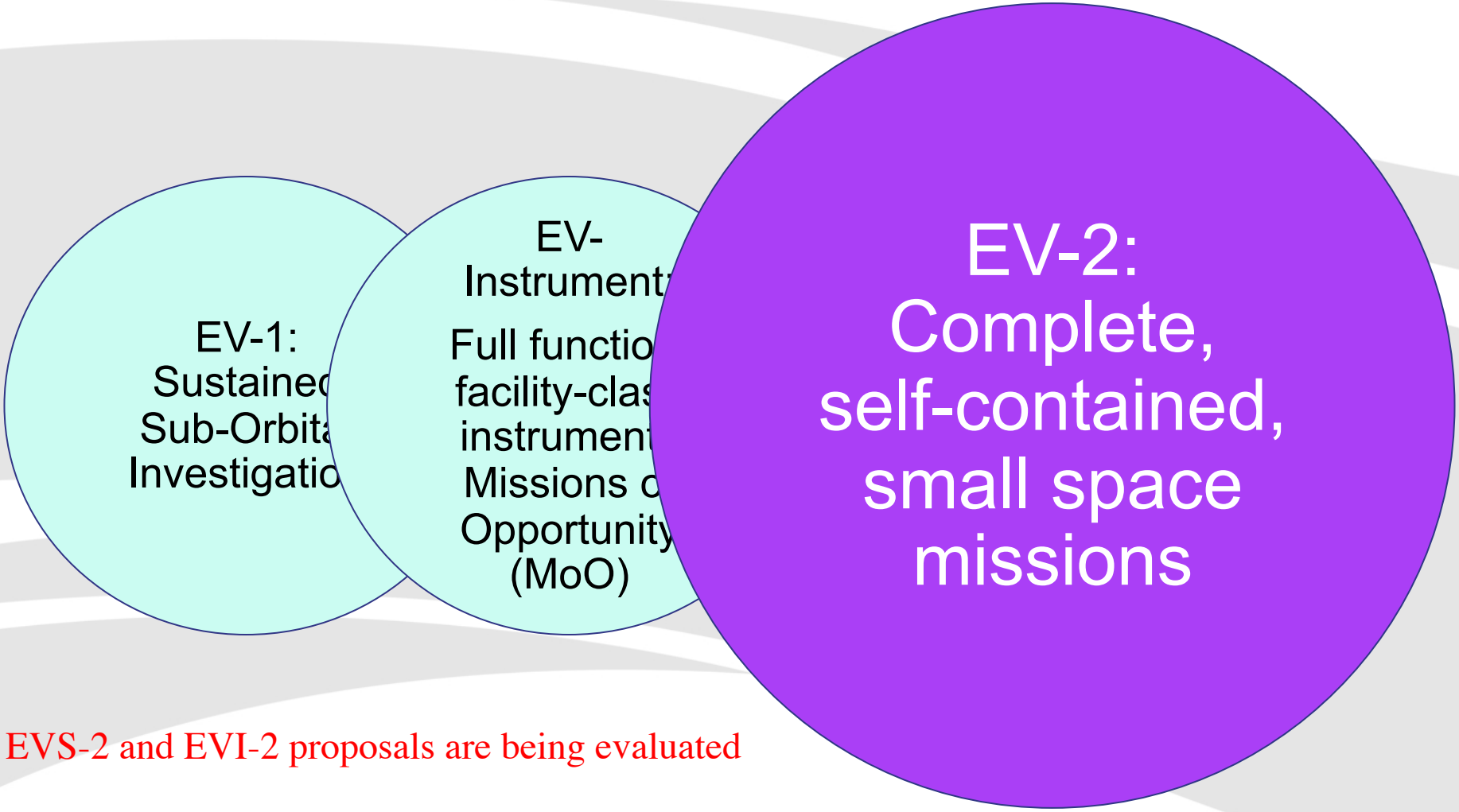
Earth Venture

- Element of ESSP Program
- Low cost research missions (sub-orbital and small satellite), instrument orbital Missions of Opportunity (MOO)

Operational Missions

- Develop and implement with partner agencies, e.g. USGS
  - Landsat Data Continuity Mission (LDCM)/Landsat 8
  - Sustainable Land Imaging

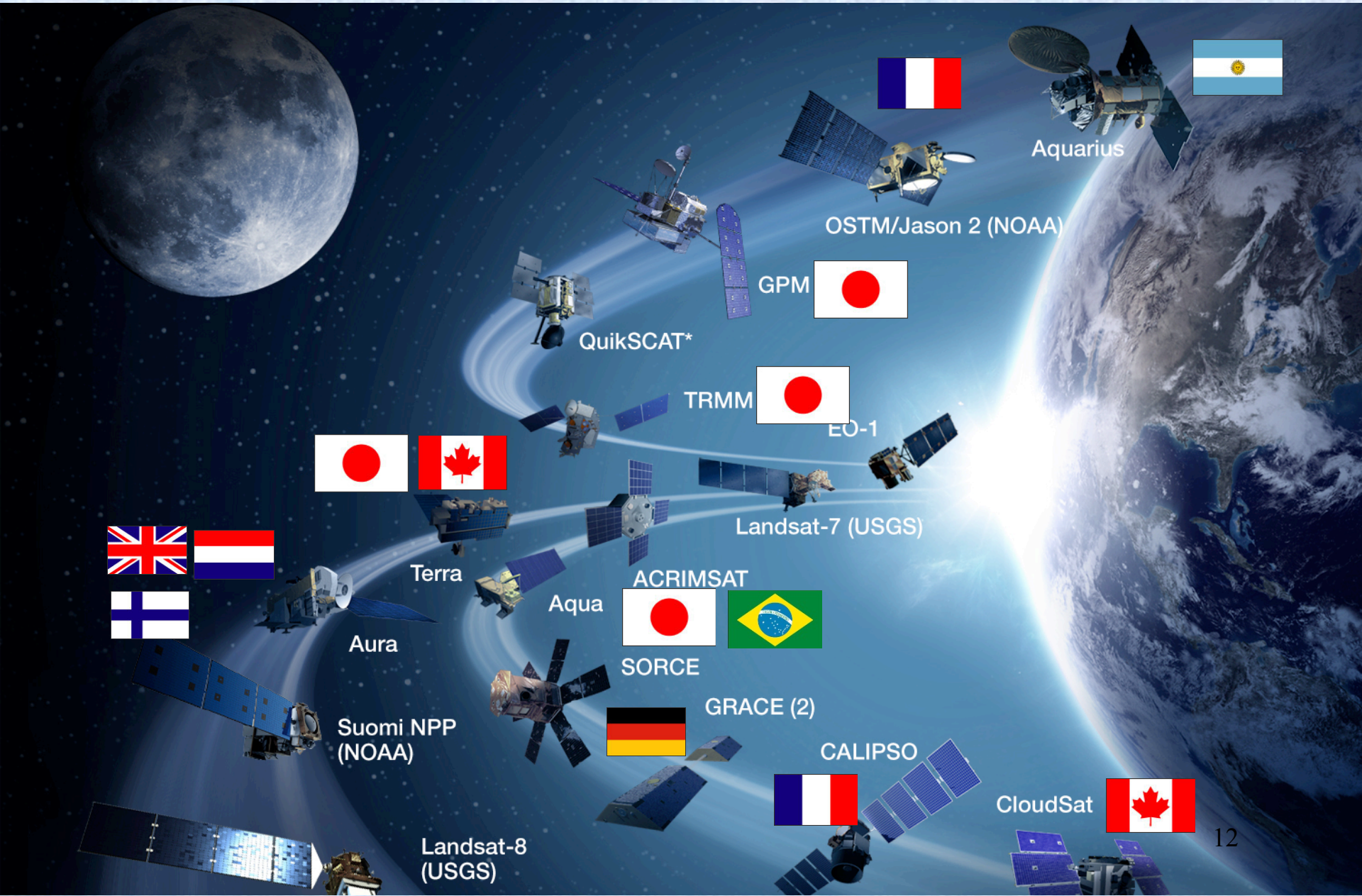
Earth Venture (EV)



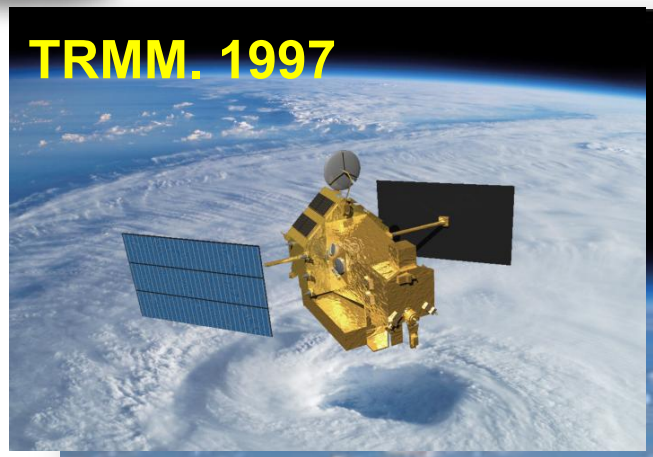
EVS-2 and EVI-2 proposals are being evaluated

EV-2 specifically allows NASA's Earth Science Division to pursue higher risk (Class D) small satellite missions with high potential science return

NASA Earth Science Operating Missions 2014



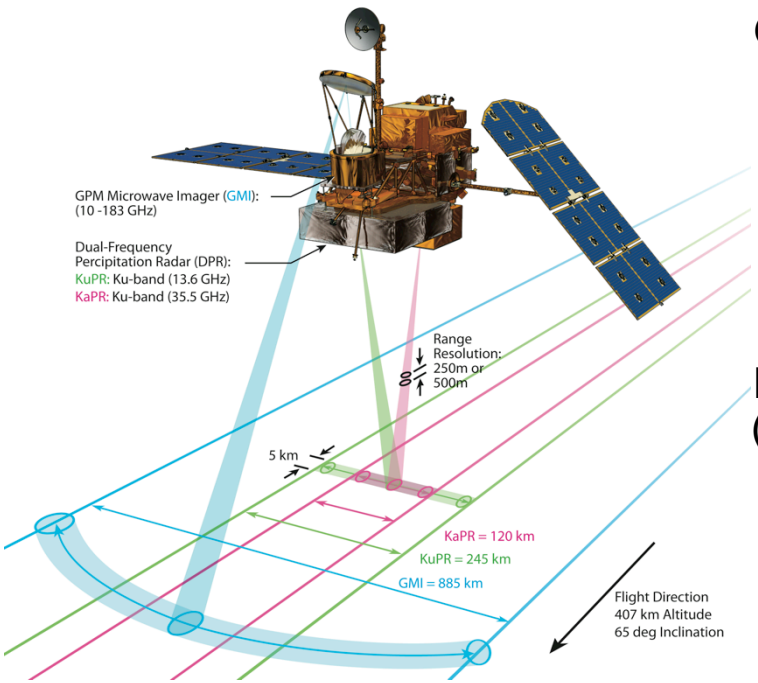
GPM will extend the TRMM data record



Launched Feb 28, 2014

GLOBAL PRECIPITATION MEASUREMENT

Core Observation Geometry and Instruments



Orbit: 407 km; 65 degree inclination

GPM Microwave Imager (GMI)

- Passive microwave radiometer with hot and cold calibration, includes novel calibration engineering
- Provides measurements of precipitation (rain and snow) intensity and distribution over wide swath (880 km)
- High spatial resolution (down to ~5km footprints)
- 166 Kg, 162 W, 34.9 Kbs Science,1.2 m diameter reflector

Dual-frequency (Ku-Ka band) Precipitation Radar (DPR)

- KuPR similar to TRMM, KaPR added for GPM
- Provides three-dimensional measurements of precipitation structure, precipitation particle size distribution (PSD) and precipitation intensity and distribution
- High spatial resolution (5km footprints)

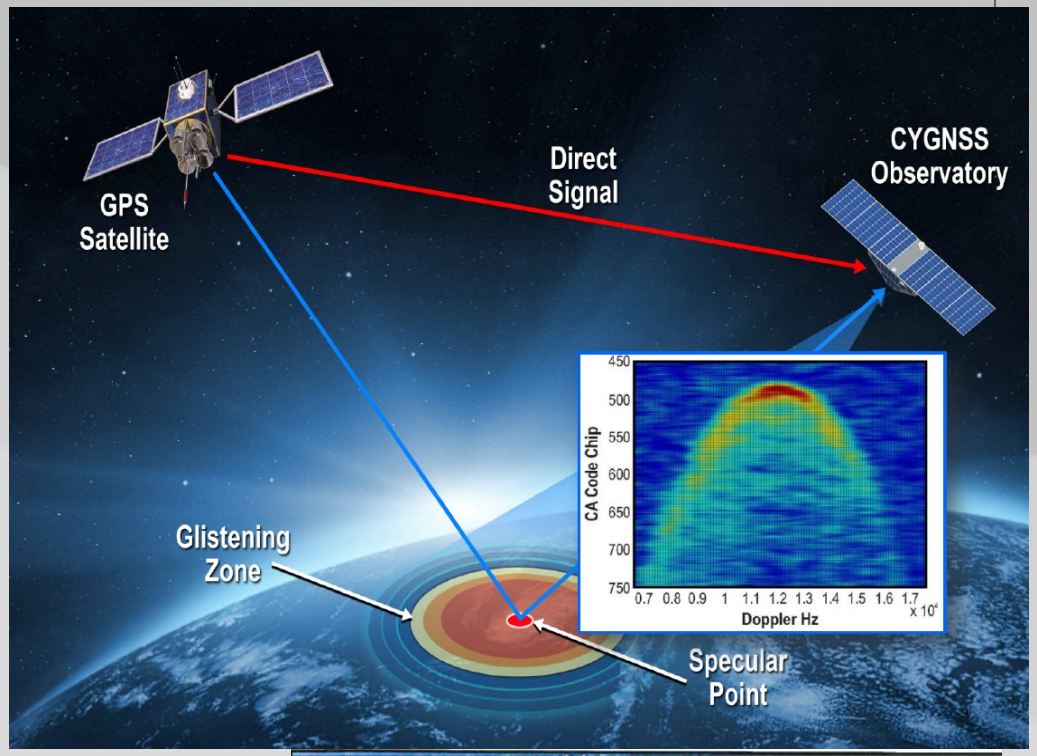
	KuPR	KaPR
Frequency	13.597 , 13.603 GHz	35.547 , 35.553 GHz
Min. detectable rainfall rate	0.5 mm/hr	0.2 mm/hr
Data Rate	< 109 kbps	< 81 kbps
Mass	< 472 kg	< 336kg
Power Consumption	< 446 W	< 344 W
Size	2.5 × 2.4 × 0.6 m	1.2 × 1.4 × 0.7 m

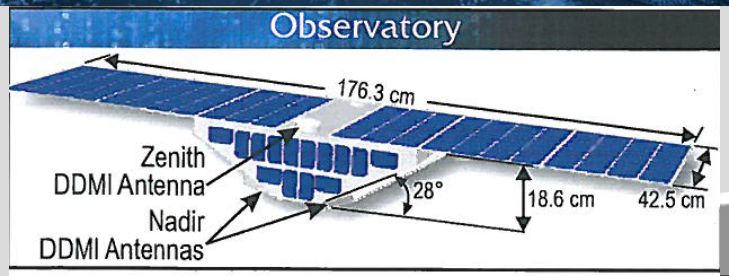
GMI Frequencies	GMI Polarizations
10.65 GHz	V/H
18.7 GHz	V/H
23.8 GHz	V
36.5 GHz	V/H
89 GHz	V/H
166 GHz	V/H
183 GHz	Va/Vb (±3 & ±7)

Earth Venture-2
(CYGNSS) Cyclone Global Navigation Satellite System

Principal Investigator: Chris Ruf
University of Michigan, Ann Arbor, MI

Cost: NASA – $150M BY14, Launch ~October 2016





- CYGNSS Science Goal
  - Understand the coupling between ocean surface properties, moist atmospheric thermodynamics, radiation, and convective dynamics in the inner core of a tropical cyclone (TC)

CYGNSS Objectives

  - Measure ocean surface wind speed **in all precipitating conditions**, including those experienced in the TC eyewall
  - Measure ocean surface wind speed in the TC inner core **with sufficient frequency to resolve genesis and rapid intensification**

Game Changing Capabilities

  - Traditional satellite remote sensing of surface winds cannot penetrate intense precipitation
    - Active (radar) and passive (radiometer) sensors operate at 1-5 cm wavelength – too much scattering and attenuation
  - Traditional LEO polar orbiters have >12 hr revisit time – too infrequent to observe rapid intensive phase of TC development

- CYGNSS uses a new measurement technique and a new satellite mission architecture

Satellite Mission Wish List

- 3D-Winds : Three-Dimensional Tropospheric Winds from Space-based Lidar
- PATH : Precipitation and All-Weather Temperature and Humidity
- NEXRAD in Space
- ARIES: Advanced Remote-sensing Imaging Emission Spectrometer
- MISTiC Winds: Midwave Infrared Sounding of Temperature and humidity in a Constellation